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ABSTRACT

System analysis is defined as a point of view as well as a set of procedures that enable decisionmakers and developers to examine approaches to social or educational problems. A list of various procedures and methods for a systematic approach to educational problems is provided. The development of a plan for a new school is described and the conceptual steps in system analysis utilized in the development are evaluated. An overall assessment of the value of the systems approach in solving educational and societal problems concludes the paper. (Author/MLF)

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THE SYSTEMS APPROACH TO EDUCATION--REVISITED

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THE SYSTEMS APPROACH TO EDUCATION--REVISITED

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I. INTRODUCTION

Two years ago at the American Educational Research Association annual meeting I presented a paper entitled "The Systems Approach to Education--The Mystique and the Reality" (1). When Dean Byrd asked me to talk to you she suggested that much of the same material would be of interest. That paper has since been published, so I welcome the opportunity to bring my thinking up to date and to analyze from a system point of view a new development which I believe will have great impact on education in the urban community.

The systems approach has been widely praised as one of the innovations of military and space technology. It is sometimes claimed that the success of major weapons and space systems can be directly attributed to the careful analysis and logical program structure resulting from the application of a system approach. The recent success of the Apollo mission can be viewed as a triumph in the application of systems analysis and advanced technology to a highly complex development. Coming from a company known as the "System Development Corporation" and having been directly involved in the development of a number of training systems in which sound system techniques have been applied, I believe I can present some first-hand experience in the application of system analysis to various training and educational problems.

My approach this morning is, first, to discuss what we mean by system analysis and to present a list of various procedures and methods that should be followed in a systematic approach to education problems. Having done this, I will next describe the development of an exciting "new school" for the cities. Then I will go through the conceptual steps in system analysis and inquire whether these steps were followed and, if so, whether they proved useful in working out this program. Finally, I will draw an overall assessment of the value of the systems approach in solving problems in education and the social arena.

II. SYSTEM ANALYSIS

System analysis is both a philosophy and a set of techniques. West Churchman (2) in his book "The Systems Approach" ably presents the philosophy on which system analysis is based. He concludes with four principles:

1. "The systems approach begins when you first see the world through the eyes of another." That is to say, the systems approach begins with philosophy because philosophy views the world through others' eyes.

2. "The systems approach goes on to discover that every world view is terribly restricted." That is, every system is bounded by a larger, more encompassing and interacting system.

3. "There are no experts in the systems approach." Expertise is confined to the application of specialized techniques, and does not include judgment of values.

4. "The systems approach is not a bad idea."--quite an admission for a philosopher.

Rather than analyzing these philosophical principles in detail, I will examine some of the methods and techniques of system analysis to determine how they lead to problem solution.

Figure 1 is a typical diagram (3) of the systems approach. It begins with a statement of the problem, which in turn leads to a consideration of the needs associated with that problem. In considering these needs, the various desired goals are defined, and a statement of objectives is prepared in light of the constraints within which the needs must be met and those capabilities available for application in achieving the objectives. Once the objectives have been defined, an analytic approach should lead to a number of alternative ways of achieving the objectives. These alternatives must then be evaluated in light of several different criteria. Selection criteria may include performance evaluations, cost-effective analysis, timing relationships relative to requirements, risks involved, and agreement with policies. The most probable alternatives are then selected for implementation or for testing in a pilot installation. As the pilot implementations become operative, the several solutions are evaluated and the results fed back for

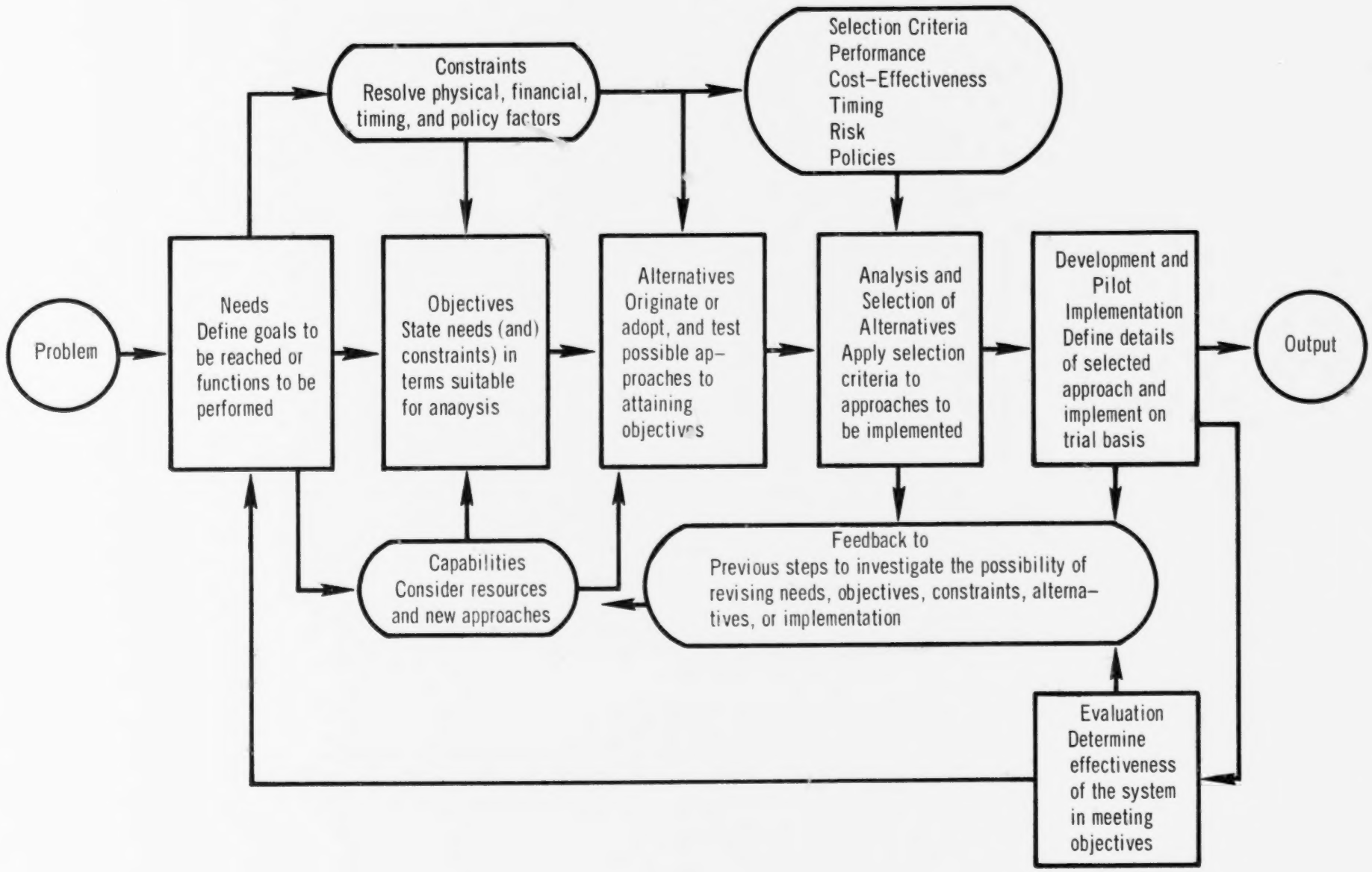
Problem
Needs
Define goals to be reached or functions to be performed
Constraints
Resolve physical, financial, timing, and policy factors
Objectives
State needs (and) constraints) in terms suitable for anaoysis
Alternatives
Originate or adopt, and test possible ap–proaches to attaining objectives
Selection Criteria
Performance
Cost–Effectiveness
Timing
Risk
Policies
Analysis and Selection of Alternatives
Apply selection criteria to approaches to be implemented
Development and Pilot Implementation
Define details of selected approach and implement on trial basis
Output
Capabilities
Consider resources and new approaches
Feedback to
Previous steps to investigate the possibility of revising needs, objectives, constraints, alterna–tives, or implementation
Evaluation
Determine effectiveness of the system in meeting objectives

Figure 1. The Systems Approach

comparisons against the statement of the problem and the goals to be achieved. The diagram emphasizes the importance of evaluation and its role in stimulating an iterative recycling of the systems approach.

Although necessarily incomplete, Table 1 provides an overview of the breadth of techniques used in system analysis. System analysis techniques are derived from many disciplines--mathematics, computer science, psychology, economics, management science--and the practitioners are usually skilled in several different techniques. These techniques are illustrated in greater detail in connection with the example that I will describe in just a few minutes.

But first, it is important to emphasize that one of the underlying prerequisites of the system analytic approach is the concept of system management, the first technique listed in Table 1. Central to the system management concept is the idea that once the problem has been stated and the objectives defined, some responsible organization will have the necessary resources and technical capability to manage the program. In the Apollo program, for example, President Kennedy stated the overall problem and goals to be achieved: namely, the landing of a man on the moon by 1970 and his safe return to this country. Once this broad goal had been defined, it was necessary that responsibilities for achieving the goal be delegated to a highly structured and well-defined organization. This, of course, was the

Table 1

SOME TECHNIQUES USED IN SYSTEM ANALYSIS

1. The System Management Concept
2. Group Meetings, Buzz Sessions, Conferences, Brainstorming
3. Surveys (Economic, Demographic, Attitudinal, etc.)
4. Interviewing
5. Bibliographic Resources
6. Behavioral Analysis
7. Program Budgeting
8. Simulation (Models on Computer)
9. Flow Diagraming
10. Mathematical Modeling
11. Simulation (Small Group Laboratory)
12. Critical Analysis of Alternatives
13. Evaluative Studies

National Aeronautics and Space Administration, which, in turn, delegated the responsibility for the Apollo program to one of its major centers, the Manned Space Flight Center at Houston. The Apollo management team contracted with many major organizations throughout the country--North American Rockwell, Boeing, Chrysler, M.I.T., and myriad others--to develop the components and facilities required for the program. Between 15 and 20 billion dollars were expended in this effort. In other words, management of this total approach--its responsibilities and available resources--was clearly defined.

In contrast, many of the urgent problems in civil areas cannot be characterized as analogous to the Apollo program. For example, there is no centralized authority or statement of responsibility for dealing with our education problems. True, the Federal Government exercises a certain degree of authority and has considerable resources available, but even in the Federal Government, responsibility for education programs is dispersed among several organizations--the Department of Health, Education, and Welfare, the Office of Education, the Office of Economic Opportunity, the Veterans Administration, the Executive Office of the President, and elsewhere. All of these organizations at the Federal level influence the rendering of education services throughout the country. But even more broadly, the various university schools of education, the state departments of education, the county and local district education departments, the private schools, the private educators--while all involved in the education problems--are relatively independent in their operation and lack a central management authority. Similar statements could be made

with respect to health or transportation or any other major civil area. In education, one need only think of the 27,000 different school districts which operate independently to appreciate the problem involved in organizing a concentrated and analytic approach to many of our educational problems. Thus we see one of the fundamental difficulties underlying the application of system analysis in a total or complete way.

While the overall system management of the education establishment is clearly impractical, a high degree of system management can still be exercised at the local level. For example, in our proposal for a new school for disadvantaged urban areas we intend that a school board, acting through the superintendent of schools, and with SDC's assistance, will exercise total system management in the development of a particular new school. Responsibility for the exercise of system management will have to be explicitly recognized and accomplished, since a surprising number of unusual problems must be solved. For example, certain state education laws must be changed before the new school will be consonant with current law. Similarly, building of a joint occupancy school, although now legal in California, is outside the tradition of California school districts and must receive special attention. Furthermore, recruiting of personnel represents a very special problem because of the characteristics required of the staff who would be comfortable in this setting. The development of curriculum materials must also proceed in a scheduled fashion for the school to be successful.

The major point I am making is that a large number of different problems

must be solved in a time-phased manner for such a new school to be successful. To accomplish this, a concentrated system management authority must undertake the successful initiation and implementation of the program. Thus, while it is possible to follow the total system management concept in a particular school district, application to broader problems facing the state and the nation is--at least at present--impossible.

III. A NEW SCHOOL FOR THE CITIES

In this country and in Europe, a number of experiments have departed from traditional modes of education. Individually prescribed instruction, which allows for high levels of student participation and freedom, new methods of reward motivation, concepts such as performance contracting and the voucher systems, and many similar innovations have all been useful within an experimental context. However, when these innovations are applied within existing school systems, under normal conditions of administration and instruction, they are often poorly implemented, and the results disappointing. We are, therefore, taking the position that a significant change in the traditional educational structures must be effected. Furthermore, the integration of many different ideas into a systematically conceived setting is required for the development of a school system which will truly fill the needs of the disadvantaged community.

In my earlier paper I described two training programs and considered the extent to which they had followed the steps of traditional systems analysis.

One of these programs was a military training effort which involved the training of crews who operated quite complex military equipment. The other program described an attempt to transform an elementary school in a disadvantaged community so that the students would perform at a higher level. This change is being achieved through the application of tutoring techniques, where children several grades above the learners are used as tutors. A second aspect of the program involves the extensive use of "encountering" and sensitivity training. Relationships were strengthened with the community itself in an attempt to get parents more involved in the education of their children.

The program I am going to describe today is an extension of our efforts to improve education in the disadvantaged community. I describe it because, as far as I know, it is the most comprehensive and thoroughly integrated program yet described in the literature. As a result of SDC's earlier work, The Ford Foundation provided a grant which allowed us to spend over a year in planning for a new school for the cities. Dan Weiler and Bob Meeker were responsible for this planning effort and have produced a truly significant document entitled "A New School for the Cities" (4). I, and many of those who have reviewed the plan, believe this analysis represents a significant departure from current practices and promises to revitalize the school as a central element in the community. It holds great promise for increasing the level of student performance, not only in traditional academic subjects, but in practical skills, in social understanding and in motivation.

Congress and the U. S. Office of Education have made a sizable fund available for the establishment of experimental schools and it is our hope that the Pasadena Board of Education will sponsor the development of such a school in the near future by accepting our proposal that Pasadena become the host district for the first prototype. As some of you may know, Pasadena is a rapidly changing community. While there are several well-to-do areas, a large portion of the city is suffering from social deterioration and the accompanying problems in education. Lately there has been a notable increase in student unrest, punctuated a year ago by a crisis involving integration. It is within this context that we are suggesting that Pasadena undertake the development of a truly "new school."

The new school is characteriszed by a number of educational features which, although not new in themselves, are subject to practical problems when initiated in the traditional school setting. Some of these features are:

1. Individually prescribed instruction in a ca efully structured curriculum.
2. An open-ended, self-directed curriculum that maximizes personal intellectual exploration, and is supported in parallel with the structured curriculum.
3. Increased student motivation and greater emphasis on problems of the real world. through features such as a student job program.
4. Programs for insuring the acquisition of social and personal skills.

5. Close monitoring of student progress and related instructional management techniques.

6. A more professional and specialized staff.

7. A close school/community relationship.

Time does not permit a lengthy discussion of the practical problems associated with achieving each of these individual features. However, it is important to note that the design of the new school is deliberately conceived to include these features in such a way that they are easily incorporated in practical application. Here I quote directly from the paper Weiler and Meeker presented to the Pasadena Board of Education.

"The new school is planned for 2,600 students: 200 per grade in grades K through 12, plus preschool and child-care facilities. This functional unification will provide greater continuity and coordination in the total educational program, make 'secondary school' facilities such as science labs available to elementary school children, provide opportunities for older students to tutor younger ones, and encourage greater community participation in school affairs especially for parents who have children of widely different ages. The school will be open 15 hours a day, 12 months of the year.

"The new school will have a dual curriculum: a structured, carefully monitored, accountable curriculum to insure measurable educational achievement in the

traditional academic subjects, and a more informal, open-ended curriculum for personal intellectual stimulation and growth. The two curricula will be independently supported and administered. The open-ended curriculum will be largely self-directed, and will feature both group and individual study. The structured curriculum will be highly individualized, and will consist of networks of curriculum units designed to be either self- or tutor-administered. One aspect of the structured curriculum is that it does away with the onus of 'failing' grades, but <u>increases</u> the ability to carefully monitor student progress, and provides much firmer, more accountable guarantees that students have in fact mastered the materials. There will be continuous analysis of the curriculum units, and the school will have the ability to replace ineffective units with revised or new material, rather than having to continue using ineffective curriculum materials for lack of better alternatives, as is the case at present.

"In addition to their academic work, all students will be able to hold paying jobs in the school. These jobs will essentially be those functions--from facility maintenance to data processing--that are necessary to operate the school, and they will play an important role in the school's program of building decision-making experience and personal responsibility. Many students will hold jobs as tutors in which they will work closely with younger students, under the direct supervision of the professional staff. For some jobs, students will be trained by faculty specifically selected for this task. Job prerequisites will be related to academic progress and

curriculum content, and even very young students will be able to earn small amounts of money by performing easy but important minor service tasks of the kind that are now typically performed in every school.

"The school plant is designed to match the school's educational functions. Students will have a choice of either individual or small group study facilities; the individualized curriculum will make obsolete the traditional classroom grouping of 30 students per teacher. Tests will be administered and analyzed in a separate facility designed for this purpose.

"Professional tasks in the new school will be differentiated into the three functional areas of curriculum, practical skills, and evaluation. Professionals will be considered independent masters of subject matter and method, will have substantial personnel and facility support, and will be compensated accordingly. Teachers will also have time put aside specifically for their own reading, study, and education, in order to support continuous professional improvement. The demands made on the teachers will be heavy--but their opportunities and rewards will also be substantial.

"A large measure of community participation is planned, in which parents will be asked to assume a number of responsibilities to the school and its students, and will also exercise substantial rights and privileges. In addition, a functioning student government is projected, under the direction

of a faculty supervisor whose responsibilities will include both the preparation of curriculum materials in government and political science, and the training of student leaders in the practical arts of self-government.

"A financial plan is an integral part of the school design. We feel strongly that if the school is to succeed, it must be financially as well as educationally sound, that it must be operable at a cost that is acceptable to the district, and must provide the means for continuity and self support without having to rely on a continuous source of special assistance, such as federal aid. The estimated operational cost of the school is $1,000 per student, per year. The district will be asked to pay the normal costs of daily operation and plant construction, as it would with any school. Federal funds will be sought to defer the extra-ordinary costs of implementation, including, in this case, a number of costs ordinarily borne by the district when erecting new buildings or starting new educational programs. The design also provides a plan for substantially reducing the cost to taxpayers of building the new school. This plan involves combining commercial or residential facilities on the same site as the school in such a way that taxes and income from those facilities can help to defer the cost of paying off the school construction bonds. A law authorizing California school districts to make such arrangements was signed by the Governor in September 1970. A publication (5) describing this system, and how it has worked in other cities, accompanies the design. In addition, should the district be unable to fully meet the daily operational cost per student in the new

school, we suggest a way to provide the required increment. This plan revolves around a federal loan arrangement similar to those that are coming into increasing use in higher education, with the funds used in this case so as to create a permanent, self-sustaining fund that can be used if necessary to supplement district operational support of the school."

IV. AN ANALYSIS OF THE APPLICATION OF SYSTEM ANALYSIS TO EDUCATION PROBLEMS

I will now consider each of the boxes in Figure 1 and comment regarding the extent to which each is appropriate in helping to solve problems in education. I will use the example of the new school just described.

A. Problem Definition and Statement of Needs

It is unnecessary to more than state the problems facing elementary and secondary schools in disadvantaged areas. The education literature is replete with discussions of inadequate solutions to the problems of morale and discipline, of student demonstrations and destruction of school property, of the uprising of parents and community members--all of which are indicative of a fundamental problem in current school practice. It was with these problems in mind that The Ford Foundation and our researchers started their efforts to design a new school for the cities.

"A New School for the Cities" contains a detailed discussion of the goals to be reached through the twelve different program features

which characterize the new school. For example, one of these features--the idea of having both a structured and an open-ended curriculum--is analyzed in terms of the projected results on student achievement level. Thus it is clear that one of the goals of the new school is to raise the level of student achievement in traditional academic subjects. However, this alone is not enough for student development, and equal emphasis is placed on an open-ended curriculum in which the student will be concerned with the broader problems of the community--with economic, political, and social considerations. Although many of the lectures, presentations, and discussions in this area will not be amenable to objective performance measurement, they will be subject to evaluation--both in terms of student response to these activities as indicated by attendance (since attendance is voluntary), and by informal assessment of student interaction with the counseling and guidance resources available in the new school.

B. Examination of Objectives in the Light of Capabilities and Constraints

Having examined the problem and defined the goals, Weiler and Meeker devote over 100 pages to the objectives to be achieved in light of the overall design. Throughout this discussion consideration is given to the resources necessary to achieve the goals, as well as the constraints within which a real school must function. Specific sections deal with the characteristics of the students, the physical plant, the curriculum, staffing and student jobs, operations in the school, community relations,

government of the school, implementation, and costs and finances. Each section, in turn, discusses the kinds of resources that would be required to undertake implementation of a new school. For example, in discussing the structured curriculum, much attention is given to organizational and structural details. It is proposed that over a thousand individual units of study will have to be built, each of which will require approximately 2 weeks' work from the students. Associated with this study unit will be appropriate textual material, audiovisual aids, and programmed instruction, culminating in a formal, objective examination. Once the student believes that he has mastered the material in a particular unit, he will report to a separate building housing the examining unit, where he will be given the appropriate test and receive certification of mastery of the material in that particular curriculum unit. The student will then progress to the next study unit.

Thus by carefully considering how this material would be prepared, how it would be used by the individual student, and how it would satisfy state requirements for achievement in specified areas, the authors specified the steps that must be achieved for this program feature of the new school. Although it must function as an integrated portion of the total new school concept, even such a straightforward component as the development of a structured curriculum must take place within

constraints. For example, for the structured curriculum concept to work properly, each student must be able to work individually and to receive individual tutoring. This imposes a constraint on the kind of physical facilities that should be available, and thus an individual room is planned for each student. Likewise, the fact that each student will be working on his own schedule and on his own course of study requires that instructional resources be available in the form of tutors. It would clearly be impossible, and probably undesirable, to have sufficient professional teacher resource available for this tutoring. Thus the solution revolves around students tutoring students, the requirement being that the student tutors must have mastered the subject matter and have been instructed in tutoring methods for that particular unit. Not only will each student tutor have a certain number of units in which he is expert, but he will be paid for this tutoring as well.

Consider the problem of scheduling in a school organized with individualized instruction and individualized tutoring. Would it be possible to have enough tutors or enough learning materials at the right times? Fortunately, at SDC we have developed a computer program which simulates the logistic aspects of the operation of such a school. The researchers were able to insert into the program the various parameters of student time, tutor time, materials resources, etc. and

run through a time-phased operation of the school to show that it could, indeed, be scheduled to operate successfully with the planned resources. This is an example of the way computer simulation can be used in system analysis. In the analysis of objectives in the light of resources and constraints of the different characteristics of the new school, Weiler and Meeker employed many different methodological techniques of system analysis. For example, they analyzed available survey information regarding the demographic and economic characteristics of the Pasadena community; engaged an architectural firm to undertake preliminary studies of the required physical plant; and studied the financing that might be available and in which the joint occupancy concept might reduce the overall burden on the taxpayers.

C. Development and Analysis of Alternative Approaches

In general, the system analysis approach requires that different alternatives be developed which would lead to the attainment of the system goals and objectives. It is apparent that certain alternatives will maximize accomplishment of some objectives, while other alternatives maximize others. Careful analytical study of available alternatives is, therefore, certainly required. The main problem is the extent to which the various alternatives can be subjected to systematic analysis in terms of well-defined selection criteria. How does one assess the performance to be obtained from several alternatives? How does

one obtain a good estimate of the cost-effectiveness of the different alternatives?

From the point of view of a particular school board in designing a new school, it is impractical to build several alternative new schools, test them, and make a formal analysis of the alternatives so the best alternative can be implemented. However, this is true only within the context of a specific development, and not within the broader context of the total effort to improve education. For example, as described in my earlier paper, SDC is currently undertaking the development of an experimental school at Pacoima. We have also done considerable work in connection with the development of individualized instruction materials and the scheduling and logistics of individualized instruction. An extensive literature is developing describing different experimental approaches to the school problem: free schools, schools without walls, schools emphasizing performance contracting--all are being developed and assessed. Indeed, the U. S. Office of Education, in establishing the experimental schools program, is deliberately encouraging different communities to develop alternative solutions to the overall school problem. Thus within the context of a single new school we are only partially able to fulfill the requirement of developing and testing alternatives, but within the larger context of the national experimental schools program the effort to develop alternatives is indeed taking place. Managers of this larger program must be particularly concerned

with the assessment of the different programs being implemented. Here they will want to insist that each experimental school maintain records of performance, community reaction, and many other variables so judgments can be made based on carefully collected information regarding the several experimental schools. Obviously, for this aspect of the program to be successful, there must be continuity of management and continuity of direction at the level of the U. S. Office of Education.

D. Development and Pilot Implementation

We are now at the point where analyses have been completed, the design of the new school has been well formulated, and alternatives have been carefully considered. Now one of the selected design approaches must be implemented. This undertaking is one of great seriousness, since its success or failure will have implications on the lives of the students involved, as well as on the school district courageous enough to undertake it. The mere construction of the new school plant will involve five to ten million dollars; should the experiment prove ineffective, the plant would require extensive remodeling to fit the traditional school pattern, and the architectural plans for the new school take this contingency into account. The experiment also has serious implications for the development company involved, for its reputation and opportunity for additional work are dependent on its ability to develop such a new school and to aid the school board in its implementation. And lastly, the U. S. Office of Education will be required to

expend a large amount of money--as well as protect its reputation--in underwriting such a venture. Nevertheless, the new school must be implemented before we can determine whether the proposed design will achieve the defined goals and objectives.

E. Feedback and Redesign

The provision for evaluation and its formal influence on redesign is an important characteristic of any system approach. The collection and analysis of information on the performance of the new school should be a well-planned and systematized activity using many of the techniques previously listed. Clearly, this calls for a team of experts trained in different disciplines--experts who can effectively collect and evaluate information on the many diverse activities that will ensue. To ascertain the successes and failures in the new school requires a continuous effort to monitor performance of all the different features. This monitoring is a major task, and must be carefully carried out.

While the evaluation of performance is important in determining the success of the original design, attention to feedback may be even more important. For this reason, the school should be fluid in design. That is, while researchers have expended their best efforts in designing a school which achieves the stated objectives, certain aspects will, of necessity, require modification as they are implemented and as experience

is collected on the functional capabilities of the various features. Information from the first implementation should be continously fed back into all earlier system steps, and the operation of the school should change dynamically as a function of this feedback.

V. AN EVALUATION OF SYSTEM ANALYSIS

Having examined a particular example, I will now consider the more general question of the extent to which system analysis can be more broadly applied to problems in education and the social arena.

System analysis involves a systematic and rational set of procedures by which a given educational, social, or technical problem can be approached. The mere listing of the various steps of system analysis and attention to feedback force a careful consideration of the many different factors which influence the outcome of a particular project. Moreover, sophisticated techniques of analysis can be used. Application of methods of mathematical analysis, modeling, simulation, scheduling, budgeting, etc., can make the full system analytic approach more rigorous and precise than traditional methods.

Moreover, system analysis forces planners to carefully think through--from beginning to end--the flow of activities or procedures that must be followed to achieve a successful outcome. Here it is particularly important to note

that part of the system analysis cycle which stresses implementation, evaluation feedback, and revision. Too frequently we attempt to solve social problems without giving much consideration to how the program will be implemented, and even less as to how it will be evaluated and revised in light of that evaluation. We seem to feel that a difficult educational or social problem can be solved in terms of a paper and pencil analytic solution without paying adequate attention to how implementation will be evaluated and what steps will be taken to feed the result of this evaluation back in a revised approach and re-implemented through successive iterations. It is certainly one of the attributes of system analysis that it forces decision-makers to face implementation problems.

In examining the various steps of system analysis it is obvious that some steps either are not, or can not, be rigorously followed in every instance. This will frequently be the case. While it is theoretically proper to talk about evaluating the several alternative solutions and selecting the one which appears most attractive, practice shows that several alternatives are rarely available and that, indeed, there might not even be one good solution to the problem. Rather, we try to ferret out--through a combination of fact, intuition, and opinion--the most likely solution to a problem; we implement it, hopefully evaluate it, and revise it. Thus we should not be too surprised if each of the steps in system analysis is not followed slavishly nor completely satisfied before we can proceed to a solution of our problem.

It is sometimes said that system analysis suffers from the defect that the whole procedure claims to be highly rational and yet, underlying the various consideration of objectives or the available alternatives are various unstated assumptions which, if stated, would reveal the questionable nature of the conclusions reached. But the procedures or techniques which have been used in lieu of system analysis appear even more subject to this criticism. It has been argued that as system analysis was applied in the Department of Defense, the experience and intuitive understanding of experienced military personnel were not given sufficient weight. There may be some truth to this argument, but one should also recognize the strongly held and often unexpressed assumptions which underlie intuitive military judgment. This same comment could be made with regard to many problems in the social and economic area. Where professional people have been working with a particular problem for many years, they have amassed a background of opinions and assumptions which are often unexpressed. The careful analytic approach characteristic of system analysis should promote expression of these assumptions and, indeed, tends to be more successful in so doing than other techniques.

Conversely, in trying to find solutions to many problems, we have insufficient knowledge to guide our judgment. This lack of knowledge frequently goes unrecognized unless we detail in a careful and analytic fashion the various steps and procedures that need to be followed in approaching the problem.

System analysis is a useful procedure when applied to appropriate kinds of problems, but at times its proponents suggest an almost universal applicability. For individual researchers working within the tradition of the scientific method on problems in the laboratory or in the field, system analysis has little to offer. Their procedures and techniques are already well established and utilize the tradition, methodology, and tools of their particular discipline. On the other hand, when fairly large and complex educational, medical, or social problems are to be solved and there is the clear intention of a systematic and concerted attack on the problem, then system analysis has a good deal to offer, although it does not contain within itself any special content knowledge regarding the solution to the problem. The careful application of system analysis leads to a better understanding and a more disciplined, scheduled approach to problem solution, but unless the context within which the problem is being approached is sufficiently flexible to allow application of the various steps in system analysis, particularly valuable results may not be realized.

In summary, system analysis is a point of view and a set of procedures which enable decision-makers and developers to examine carefully and systematically the way in which a social or educational problem might be approached. It outlines a schedule of activities and emphasizes the areas in which problems may arise. But system analysis as an approach does not in itself assure the successful solution of a problem. Rather, it represents the formalization

and procedural expression of the approach that wise, systematic, and technically astute men have always taken in trying to solve their problems.

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